REMARKS

The Claims

Claims 1-102 are currently pending. Claims 1-3 have been rejected under 35 U.S.C. §102(b) as being anticipated by Nagai et al. (U.S. Pat. No. 5,902,395). Claims 1-102 have been rejected under 35 U.S.C. §103(a) as being obvious over Nagai et al. in view of Holder (U.S. Pat. No. 5,588,993). Claims 1-3, 59, 60, and 68 have been amended.

Section 102(b) Rejections; Nagai et al.

Reconsideration is requested of the rejection of claims 1-3 under 35 U.S.C. §102(b) as being anticipated by Nagai et al.

Claim 1 is directed to a process for preparing a silicon melt in a crucible to grow a single crystal silicon ingot that requires **intermittently** delivering additional polycrystalline silicon **into the rotating crucible** from which an ingot is grown onto the exposed unmelted polycrystalline of a partially melted charge. Conversely, Nagai et al. disclose **continuous** discharge of the silicon from the feed pipe into the crucible, as seen in the following quotations:

> rotation of the crucible makes it possible to continuously feed the granular silicon material to the unmolten layer. Col. 6, lines 8-10. Emphasis added.
>
> As a result [of rotating], it is possible to continuously feed the granular silicon material to the unmolten layer. Col. 6, lines 64-65. Emphasis added.

Nagai et al.'s reference to repeatedly commencing and stopping a feed of silicon material does not relate to the manner in which silicon is delivered to the growth crucible. Rather, it relates

to the feeding of silicon **from a feeder into a feed pipe**. This is not the same as claim 1's requirement of intermittent delivery of silicon into the growth crucible.

The Office asserts that "[t]he unmelted polycrystalline in the feed tube, which is in contact with the melted silicon in the crucible, reads on applicant's unmelted polycrystalline silicon." Applicant respectfully requests reconsideration because claim 1, as amended, explicitly requires the following:

> Claim 1. ...(a) forming a partially melted charge in the crucible, the unmelted polycrystalline silicon comprising an exposed portion that is above the upper surface of the molten silicon;
>
> (b) rotating the crucible;
>
> (c) feeding additional polycrystalline silicon into the rotating crucible by intermittently delivering the additional polycrystalline silicon [i] **onto the exposed portion of the unmelted polycrystalline silicon of the partially melted charge**, [ii] **in the crucible** from which the single crystal silicon ingot is grown ....

Claim 1 conspicuously requires that the surface onto which the additional polycrystalline silicon is intermittently delivered in step (c) is the exposed unmelted polycrystalline silicon generated in step (a). This exposed unmelted polycrystalline silicon is generated **in** the crucible and, in particular, in the crucible from which the single crystal silicon ingot is grown. Moreover, the surface onto which the silicon is delivered is an exposed **portion of the partially melted charge**.

Nagai et al.'s silicon in the feed pipe is not "in the crucible" in the sense that applicant's exposed silicon portion is "in the crucible." And to underscore this, applicant has further amended claim 1 to underscore that this exposed silicon portion onto which delivery occurs intermittently is a portion of

the partially melted charge. This further distinguishes this from Nagai et al.'s silicon which is in their feed pipe: the silicon in their feed pipe is a distinct body of silicon, and is not a portion of any partially melted charge.

The foregoing differences are further underscored by the fact that Nagai et al. distinguish the process operation of feeding into the feed pipe from the process operation of feeding into the growth crucible by dealing with each separately in their SUMMARY OF THE INVENTION: silicon transfer from the feeder to the feed tube is discussed from Col. 3, line 42 to Col. 4, line 59, whereas silicon discharge from the feed pipe into a crucible is discussed from Col. 4, line 60 to Col. 7, line 12. Further, Nagai et al.'s extended discussion of the relationship between the "feed rate" and the "discharge rate" from Col. 8, line 20 to Col. 9, line 14 underscores the distinction between these two operations within the process.

Claims 2 and 3 have similar requirements of intermittent delivery of silicon onto the unmelted polycrystalline silicon in the rotating crucible. As such, they are patentable over Nagai et al. for the same reasons set forth above regarding claim 1.

Section 103(a) Rejections

Reconsideration is requested of the rejection of claims 1-102 under 35 U.S.C. §103(a) as being obvious over Nagai et al. in view of Holder.

Claims 1-35

Claim 1 is directed to a process for preparing a silicon melt in a crucible to grow a single crystal silicon ingot that requires **intermittently** delivering additional polycrystalline

silicon onto the exposed unmelted polycrystalline of a partially melted charge into the rotating crucible. As noted above, Nagai et al. fail to require intermittent delivery of silicon in a rotating crucible, and in fact teach away from intermittent delivery of silicon into a crucible from which the single crystal silicon ingot is grown. Holder does not remedy this deficiency, as there is no disclosure of intermittent delivery of silicon therein.

Again, Nagai et al. disclose a method for creating a silicon melt that comprises rotating the crucible to permit **continuous** discharge of the silicon from the feed pipe to the crucible, thereby preventing clogging in the feed pipe. (Col. 6, lines 8-13 and 59-65). Nagai et al. do not disclose rotation of the crucible in conjunction with intermittent discharge of the silicon into the crucible.

In contrast, claim 1 explicitly requires rotation of the crucible and a plurality of deliberate, planned on-periods and off-periods. Nagai et al. not only fail to disclose such a requirement, but characterize intermittent discharge as an undesirable consequence that can be avoided by crucible rotation, according to the following:

> If the crucible is not rotated, the feeding of the granular silicon material to the unmolten layer through the feed pipe becomes intermittent, so that there continues a state in which the granular silicon material does not move in the feed pipe and eventually becomes melted, which may result in clogging of the feed pipe. However, rotation of the crucible makes it possible to continuously feed the granular silicon material to the unmolten layer. Accordingly, the granular silicon material can be constantly placed in a state in which it always moves in the feed pipe, which in turn makes it possible to prevent clogging of the feed pipe. (Col. 6, ln. 2-13.)

Accordingly, Nagai et al. teach away from the express requirement of claim 1 that the additional polycrystalline silicon be fed by intermittent delivery onto an exposed unmelted portion which is a portion of the partially melted charge. Holder makes no mention of intermittent delivery of silicon into a crucible therein. One skilled in the art would not receive any instruction from Nagai et al. alone or in view of Holder to contemplate intermittently delivering silicon into the crucible. As such, claim 1 is not obvious over Nagai et al. in view of Holder, and is therefore patentable.

Claims 2 and 3 are patentable for the same reasons as claim 1 because they similarly require intermittent delivery of silicon into the rotating crucible.

Claims 4-35 all depend directly or indirectly from claim 3, and are patentable over Nagai et al. for the same reasons set forth above regarding claim 1 and for the additional requirements recited therein.

With specific regard to claim 35, the Office stated that FIGS. 2 and 3 of Holder disclose a spray-type feed tube. This assertion is incorrect. Figures 2 and 3 of Holder disclose a vertical-type feed tube. A spray-type feed tube is depicted in FIGS. 6 and 7 of the Application and is described at page 16, line 23 to page 17, line 3 of the Application (Publication at paragraph 42).

Claims 36-58

Claim 36 requires that the portion of the exposed unmelted polycrystalline silicon upon which granular polycrystalline silicon is delivered be a wedge that extends radially outward from about the center to the interface between the unmelted

polycrystalline silicon and the upper surface of the molten silicon. None of the cited references discloses depositing the polycrystalline silicon onto a wedge of unmelted polycrystalline silicon. Figures 2 and 3 of Holder depict silicon being deposited over the center of an unmelted charge, which randomly disperses the silicon over the entire surface instead of directing the deposited silicon over a wedge. Nagai et al. disclose a continuous flow of silicon, which does not deposit the silicon on a wedge that extends radially outward from about the center of the unmelted polycrystalline silicon to the interface between unmelted polycrystalline silicon and the upper surface of the molten silicon. None of the cited references discloses, teaches, or suggests controlling the deposition pattern of polycrystalline silicon in a manner so that the deposited material resides on a wedge of the unmelted polycrystalline surface as required by claim 36. As such, claim 36 is nonobvious and patentable.

Claims 37-58 depend from claim 36 and are patentable for the same reasons and for the additional requirements thereof.

With specific regard to claim 52, claim 52 requires that there be no substantial overlap between each wedge and the immediately preceding wedge. Claim 53 requires that granular polycrystalline silicon be deposited on the entire exposed unmelted polycrystalline silicon prior to redepositing granular polycrystalline silicon on any wedge. Claims 54-57 depend from claim 53 and set forth the placement of deposits with respect to particular locations (i.e., wedges) and crucible rotation. Claim 58, in contrast to claim 53, requires granular polycrystalline silicon to be redeposited on a wedge prior to depositing granular polycrystalline silicon on the entire exposed unmelted

polycrystalline silicon. None of the cited references, however, discloses controlling the feeding of polycrystalline silicon into a crucible in a manner that prescribes intervals between the redeposition of polycrystalline on a particular portion of the unmelted polycrystalline surface or the locations of subsequent deposition areas. As such, claim 52-58 are nonobvious and patentable.

D. Claims 59-102

Claims 59-102 independently incorporate or depend from claims that incorporate requirements similar to claim 1; namely, that there be **intermittent** delivery of additional polycrystalline silicon onto the exposed unmelted polycrystalline of a partially melted charge **into the rotating crucible**. Therefore, these claims are patentable for the same reasons as set forth for claim 1 and for the additional requirements therein.

In light of the foregoing arguments, Applicant respectfully requests that a Notice of Allowance be issued for claims 1-102.

Respectfully submitted,

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